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CALIBRATING and MAINTAINING SPRAY EQUIPMENT

B. J. Butler and J. C. Siemens

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Spraying insecticides on corn with three nozzles per row.

CALIBRATING AND MAINTAINING SPRAY EQUIPMENT

The use of spray equipment for weed and insect control offers unlimited possibilities, particularly in the light of the large number of effective pesticides now available. While perfect control with chemicals cannot be expected, more and more cases are being found where they are economically justified to supplement sound cultural practices. Sprayers cost less than many other farm machines and most of the chemicals are not expensive. These useful chemicals, however, are no better than the way they are applied. A poor application can easily cause damage that runs into thousands of dollars. Spraying for weed and insect control is a precision operation. It has tremendous potential for saving a crop or increasing yields, but misuse may completely ruin a crop.

To be precise and accurate, spray applications should meet the following conditions.

1. The type and size of the nozzles should be selected to provide the proper particle size and application rate.

This corn was sprayed with 2,4-D at a rate higher than was recommended. (Fig. 1)

Urbana, Illinois March, 1971

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2. The pressure should be regulated to give proper nozzle discharge rate, spray pattern, and drop size.

3. The nozzle should be located so the target area will be well covered with a minimum amount of spray escaping from that area.

4. The ground speed should be adjusted to apply the correct rate and should be kept uniform.

5. No more pesticide than necessary should be applied. This is not only economical, but prevents excessive pesticide accumulation.

6. The proper proportions of pesticides and water must be mixed together and kept mixed by adequate agitation before and during application.

All these items are important and closely related. A single variation from these requirements may give poor control or, much worse, extensive crop damage.

Selecting nozzles

Three types of nozzles are recommended for applying sprays to field crops in Illinois. They are the hollow cone, the flat-fan, and the flooding flat-fan types. The broadcast nozzle is sometimes used, but is more satisfactory for use on fence rows, pastures, and roadsides.

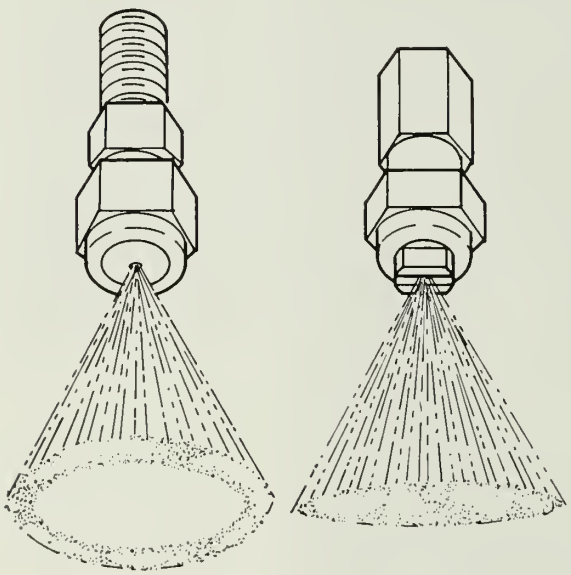
This corn row has been kept clean by band spraying with a pre-emergence chemical. (Fig. 2)

The hollow cone nozzle (Fig. 3) breaks up the spray into smaller droplets than does the flat-fan nozzle, thus giving more complete coverage of a sprayed surface. These smaller droplets, however, will result in more fogging and drifting. The hollow cone nozzle, because of its conical pattern, will penetrate under leaves and between obstacles better than flat fan nozzle types. Using a hollow cone nozzle is more desirable than using a flat-fan nozzle with some insecticides and most fungicides where complete coverage is desired and where some drifting is not necessarily a hazard.

The hollow cone nozzle, including the whirl chamber type, will not provide very uniform coverage when used to spray the soil surface unless the nozzles are tilted forward or backward on the boom at an angle of 15 to 30 degrees from vertical.

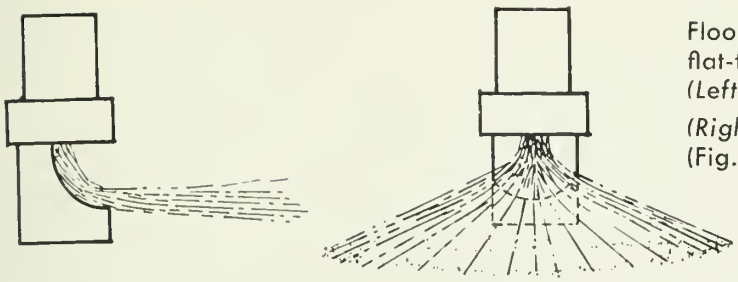
The regular flat-fan nozzle (Fig. 3) produces a fairly coarse spray in a flat-fan pattern. With the patterns of adjacent nozzles overlapped by 25 percent, better distribution of the spray is obtained than is possible with the hollow cone. This nozzle gives very satisfactory results when used for applying most herbicides, either pre- or post-emergence, and for applying many insecticides. At the same application rate and pressure, the spray has less tendency to drift than spray from the hollow cone nozzle.

At low pressures of 5 to 20 p.s.i. (pounds per square inch), the



(Left)
Hollow cone nozzle.

(Right)
Regular
flat-fan nozzle.
(Fig. 3)



Flooding type flat-fan nozzle. *(Left)* side view. *(Right)* front view. (Fig. 4)

flooding type flat-fan nozzle will produce a satisfactory distribution pattern for applying herbicides. This pattern is very resistant to drifting (Fig. 4). The spray has less tendency to drift than the spray from either the regular flat-fan or hollow cone nozzles, at pressures below 40 p.s.i. The flooding type nozzle is recommended for use in areas where damage from drift is likely to occur.

A broadcast nozzle works well on roadsides such as these, fence rows, and brushy pastures. (Fig. 5)

Because of its wide fan angle, the flooding flat-fan nozzle is quite popular for surface application of liquid fertilizers. Nozzles on 40- to 144-inch centers provide a wide swath through fewer and larger orifices which are less likely to clog. When used to apply mixtures of fertilizers and pesticides, nozzle spacings should be reduced to 40 inches to avoid drift and distortion of the pattern because of wind and for better distribution. Adequate patterns are easily obtained at pressures below 20 p.s.i., which results in coarse droplets less prone to drifting. Pressure changes cause considerable change in spray angle and pattern, so once an adequate pattern has been obtained pressure should be held constant. This is true for all types of nozzles, but is especially so for flooding nozzles.

The broadcast nozzle (Fig. 5) provides wide coverage with a single nozzle. Under favorable conditions, it will cover up to 20 feet to one side or up to 40 feet on both sides. The spray is more exposed to wind than is spray from nozzles placed along a spray boom, and distribution across the swath is poorer. The nozzle produces small droplets under the nozzle but extremely large droplets at the outer edge of the swath. Consequently, the distance between droplets on the outer edge of the swath may be too great for complete control of pests.

The broadcast nozzle can be used where increased amounts of

Table 1. — Nozzle Types for Use on Field Crops

Type	*Suggested use*	*Recommended pressures*	*Types of spray pattern*
Hollow cone	Most insecticides and fungicides	60–100 p.s.i. and above; below 30 p.s.i. if used for weed control	Circular with light application in center; fine spray droplets
Flat fan	Pre-emergence and post-emergence herbicides; some insecticides	15–30 p.s.i., never over 40 p.s.i. for weed spraying	Fan-like pattern of medium droplets
Flooding flat	Pre-emergence and post-emergence herbicides where drift is hazardous, liquid fertilizers	5–20 p.s.i. for maximum drift control; below 30 p.s.i. otherwise	Fan-like pattern of coarse droplets that are still numerous enough for weed control
Broadcast	Weed and brush control in pastures, fence rows, and along roadsides	10–30 p.s.i., never over 40 p.s.i.	Fan-like wide coverage with fine droplets under nozzle increasing to very coarse droplets at outer edge of 15–25 ft. pattern

pesticide can be used and where good surface coverage is not absolutely necessary. Therefore it is not recommended for field crops, but is suggested for spraying pastures, fence rows, and roadsides where obstructions make a boom undesirable (Fig. 5).

More information about the various types of nozzles is given in Table 1.

Most herbicides and insecticides used in Illinois do not require complete coverage of sprayed surfaces. The most desirable nozzle for field crops is usually the flat-fan nozzle used at a low pressure and with low flow rates. The combination of low pressures and low capacity flat-fan nozzles results in low application rates that permit spraying an area with a minimum of liquid and with little danger of drift. However, even slight drifting of 2,4-D and other herbicides can cause damage to sensitive crops and ornamentals at fairly great distances. Spraying on windy days is highly undesirable. Extensive drifting also causes a decrease in effectiveness of the spraying since the amount applied to the area being treated is reduced (Fig. 6).

In most cases pressures of 20 to 30 p.s.i. are desirable, never over 40 p.s.i., for applying 2,4-D and other drift-sensitive pesticides. Never use nozzles rated at less than 5 gallons per acre, because such small orifices will produce fine spray particles that will drift easily and the nozzles or nozzle screens will clog too often for practical use.

High nozzle pressure is causing excessive atomization of the spray and drifting that will damage ornamentals in the area. (Fig. 6)

Using a hand gun with increased pressure to reach distant brush and weeds is practical where drift is not a problem. (Fig. 7)

Regulating nozzle pressure

Within rather narrow limits, nozzle pressure can be regulated to vary the output of the sprayer. The lower pressure limit is the one that will give an adequate spread or fanning. The upper limit is normally 30 p.s.i. for weed spraying, but in nonsensitive crop areas it may be as high as 40 p.s.i., never over 40 p.s.i. For other types of spraying, where drift is not a problem and as long as wind does not affect delivery of the spray onto the plant or ground, higher pressures for obtaining finer droplets or for obtaining higher output can be used up to the limits set by the spray pump (Fig. 7).

WARNING: Do not operate at high nozzle pressures to compensate for using the wrong nozzle size. If your nozzle produces only half as much spray as you want at 30 p.s.i., you must increase the pressure on the nozzle to 120 p.s.i. to get the output you want. This increased pressure will produce so many small droplets that you will have little control over drift.

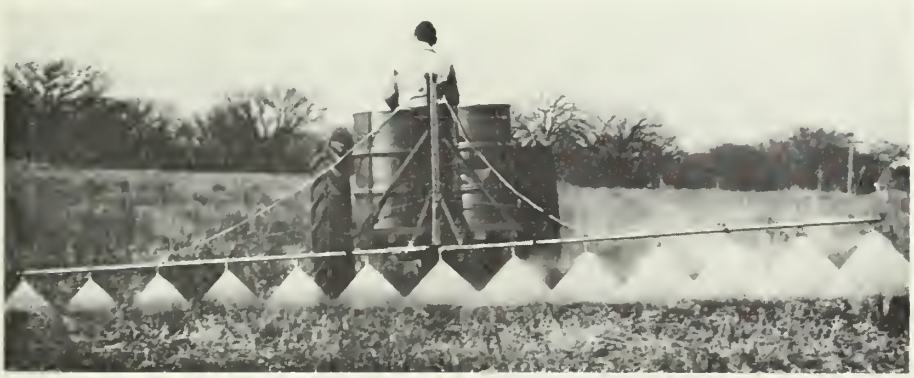
Location of nozzles

Proper location of nozzles depends on the type of spraying being done. Place nozzles with these two things in mind: (1) spraying a certain surface and no more; and (2) keeping the nozzle close to the surface; the farther away it is the more danger there is of drift.

Use a nozzle arrangement and nozzle height (distance from the surface being sprayed) that will give a good pattern. Increasing the height encourages drifting (Fig. 9). In broadcast spraying with the

Raising one section of a boom to spray a fence row is satisfactory as long as the wind is low and susceptible crops are not nearby. (Fig. 8)

normal 20-inch spacing of the nozzles, the height of the nozzles should be 17 to 19 inches above the ground or above the foliage as the case may be. For band spraying with the normal 13-inch band, the height of the nozzles should be about 8 inches. Always check nozzle patterns in the field.



On the left, this boom is too low; coverage is incomplete with gaps between nozzle patterns. The pattern of overlapping for the three center nozzles is correct. On the right, the boom is too high, giving improper coverage where the patterns overlap. Also, spray at this height is more likely to drift. (Fig. 9)

Ground speed

Higher ground speeds permit the use of nozzles with larger orifices to apply the same rates per acre as would be applied at a lower speed. Application rates per acre are lower at the higher speed, if you do not increase orifice size or pressure. Using the larger orifices will decrease the danger of drift and nozzle clogging problems. Speeds of 3 to 8 miles per hour are reasonable, depending on field conditions, but speeds of more than 8 miles per hour may cause parts of the sprayer to break or the bouncing of the sprayer may cause gaps in the pattern. Once nozzle spacing, size, and pressure have been selected, the only major factor left for changing rate of application is ground speed. A change in ground speed changes the rate of application much faster than does a change in nozzle pressure. For instance, spraying at 6 miles an hour instead of at 3 miles an hour with nozzles of the same size, spacing, and pressure will cut the rate of application in half.

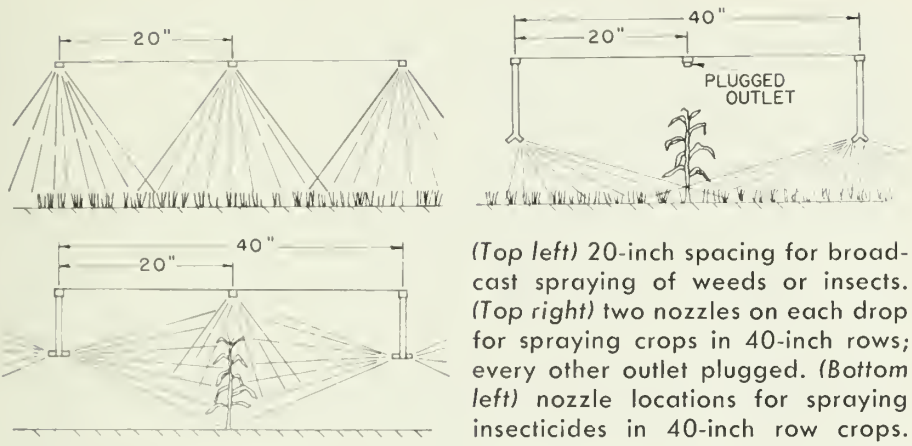
Economical pest control

Economical pest control means using only enough chemical to control the pest without damaging susceptible crops or animals. By not using too much, you may not only save on cost, but may also save your crop; this is especially true of herbicides. The chemicals approved for field use are highly selective and safe when used at the rates recommended. When used at higher rates, however, they lose their selectivity and may very well kill or injure not only your pests, but your present or next year's crop.

Spray calibration

Most sprayers in Illinois have boom outlets for nozzles on 20-inch centers (Fig. 10). The trend to narrow rows has resulted in more sprayers with adjustable nozzle spacing. The nozzles can be equally spaced along the boom at any reasonable spacing or positioned as shown in Figure 10 for different spray applications. To calculate application rates the nozzle spacing must be known. The nozzle spacing is equal to the row spacing divided by the number of nozzles used per row.

Once nozzle spacing is determined, the volume of spray applied per acre depends only on nozzle output and ground speed. For postemergence weed control, not less than 5 or more than 10 gallons per acre is normally applied. Preemergence weed control and field



(Top left) 20-inch spacing for broadcast spraying of weeds or insects. *(Top right)* two nozzles on each drop for spraying crops in 40-inch rows; every other outlet plugged. *(Bottom left)* nozzle locations for spraying insecticides in 40-inch row crops. (Fig. 10)

spraying for insects rarely call for more than 20 gallons per acre. Table 2 was prepared for this range of gallonages per acre and for a reasonable range of ground speeds.

Use of Table 2

The nozzle outputs required for different combinations of ground speed and application rate are given in gallons per minute and ounces per minute. The gallons-per-minute figure is useful for selecting nozzles, but nozzle output for calibrating is more easily determined in ounces. To convert gallons per minute to ounces per minute, multiply gallons per minute by 128. To convert ounces per minute to gallons per minute multiply by 0.0078.

You can use Table 2 for calibrating nozzles in the field. Suppose you want to apply 10 gallons per acre at a ground speed of 6 miles per hour using a 20-inch nozzle spacing; from Table 2, you find an output of 0.202 gallon per minute (25.9 ounces) is needed. If you can obtain this output within the range of pressures recommended you can prepare your spray mixture, adjust pressure until you get the 25.9 ounces per minute, and be confident that if you spray at 6 miles per hour you will apply 10 gallons per acre.

You can use Table 2 for selecting the proper ground speed when operating at a given nozzle pressure and output. Suppose you want to spray at 30 p.s.i. with a 20-inch nozzle spacing. At this pressure, your nozzles produce an output of 18 ounces per minute which is equal to 0.14 gallon per minute. By looking in the various columns of Table 2, you find you can put on 6 gallons per acre at 7 miles per hour, 7 gal-

Table 2. — Nozzle Outputs; 15-, 18-, and 20-Inch Nozzle Spacings

Nozzle spacing (inches)	Ground speed (miles per hour) 4		5		6		7		8	
	gal. per min.	oz. per min.	gal. per min.	oz. per min.	gal. per min.	oz. per min.	gal. per min.	oz. per min.	gal. per min.	oz. per min.
					5 gallons per acre					
15	.053	6.8	.067	8.6	.081	10.4	.094	12	.107	13.7
18	.060	7.7	.076	9.7	.091	11.6	.106	13.6	.122	15.6
20	.067	8.6	.084	10.7	.101	12.9	.118	15.1	.135	17.3
					6 gallons per acre					
15	.065	8.2	.081	10.4	.097	12.4	.113	14.5	.130	16.7
18	.073	9.4	.091	11.6	.109	14	.127	16.3	.146	18.7
20	.081	10.4	.101	12.9	.121	15.5	.141	18	.162	20.6
					7 gallons per acre					
15	.075	9.6	.094	12	.113	14.5	.132	16.9	.151	19.3
18	.085	10.9	.106	13.6	.127	16.3	.149	19.1	.170	21.8
20	.094	12	.118	15.1	.141	18	.165	21.1	.189	24.2
					8 gallons per acre					
15	.086	11	.108	13.8	.130	16.7	.151	19.3	.173	22.2
18	.097	12.4	.122	15.6	.146	18.7	.170	21.8	.194	24.9
20	.108	13.8	.135	17.3	.162	20.7	.189	24.2	.216	27.6
					9 gallons per acre					
15	.097	12.4	.122	15.6	.146	18.7	.170	21.8	.194	24.9
18	.109	14	.137	17.5	.164	21	.191	24.5	.218	27.9
20	.121	15.5	.152	19.4	.182	23.3	.212	27.1	.242	31
					10 gallons per acre					
15	.107	13.7	.134	17.2	.162	20.6	.189	24.2	.215	27.5
18	.122	15.6	.151	19.3	.182	23.3	.212	27.1	.242	31
20	.135	17.3	.168	21.5	.202	25.8	.236	30.2	.269	34.5
					15 gallons per acre					
15	.162	20.7	.202	25.8	.242	31	.283	36.2	.323	41.3
18	.182	23.3	.228	29.2	.273	35	.319	41	.364	46.6
20	.202	25.8	.253	32.4	.303	38.8	.354	45.3	.404	51.7
					20 gallons per acre					
15	.215	27.5	.270	34.6	.323	41.3	.378	48.5	.430	55.1
18	.242	31	.303	38.8	.364	46.6	.425	54.5	.484	62
20	.269	34.5	.337	43.2	.404	51.7	.472	60.5	.538	69

lons per acre at 6 miles per hour, or slightly over 8 gallons per acre at 5 miles per hour. The speed you select should depend on the roughness of the ground and the speeds you can get from your tractor or self-propelled sprayer. If you select 6 miles per hour and adjust the machine speed accordingly, you will put on 7 gallons per acre.

You can use Table 2 for selecting a new set of nozzles. Suppose that you want a set of flat-fan nozzles to apply 5 to 10 gallons per acre at 20-inch nozzle spacing and your ground speed can be varied from 4 to 7 miles per hour. Your lowest speed will put on the highest

rate. At 4 miles per hour and the desired 10 gallons an acre, you need an output of 0.135 gallon per minute; at 7 miles per hour and 5 gallons per acre, you need an output of 0.118 gallon per minute (Table 2). A nozzle having an output of 0.118 gallon per minute at 15 p.s.i. will also produce the 0.135 gallon per minute needed to apply 10 gallons per acre at less than 40 p.s.i. Such a nozzle will be satisfactory for applying 5 to 10 gallons per acre at speeds from 4 to 7 miles per hour.

Use of Table 3

After determining the nozzle pressure, speed, and gallons per acre that you will be using, you must prepare the proper amount of pesticide in the proper strength.

Table 3 can be used to determine how many acres you can spray per tankful once gallonage per acre is known. If only a small acreage is to be sprayed, Table 3 can be used to determine how much solution to prepare.

Suppose you intend to apply 7 gallons per acre and the capacity of your tank is 150 gallons. Go to Table 3 and find the 7 gallon-per-acre line (left side of page) and then the 150-gallon column (top, third from the right). There you will find that at 7 gallons per acre 150 gallons will spray 21.4 acres. If you have less acreage to spray, say 15 acres, look across the 7-gallons-per-acre column; there you will find that you need an amount halfway between 100 and 110 gallons, so you put enough pesticide in the tank for 15 acres and add enough liquid to make 105 gallons.

Table 3. — Acres Sprayed per Tankful — Broadcast Spraying

Gallons per acre	Acres per tankful for various tank capacities, gallons									
	30	50	55	60	75	100	110	150	200	500
5	6.0	10	11	12	15	20	22	30	40	100
6	5.0	8.3	9.2	10	12.5	16.7	18.3	25	33.3	83.3
7	4.3	7.1	7.9	8.6	10.7	14.3	15.7	21.4	28.6	71.4
8	3.8	6.3	6.9	7.5	9.4	12.5	13.7	18.8	25.0	62.5
9	3.3	5.6	6.1	6.7	8.3	11.1	12.2	16.7	22.2	55.6
10	3.0	5.0	5.5	6.0	7.5	10.0	11.0	15.0	20.0	50.0
15	2.0	3.3	3.7	4.0	5.0	6.7	7.3	10.0	13.3	33.3
20	1.5	2.5	2.8	3.0	3.8	5.0	5.5	7.5	10.0	25.0

To find from this table the crop acreage actually covered when band spraying, apply the following formula:

$$\text{crop acres band sprayed} = \frac{\text{acres per tankful} \times \text{row width (inches)}}{\text{width of band (inches)}}$$

Using a quart measuring jar to determine the output of a nozzle in ounces per minute. (Fig. 11)

Your tank should be marked for every 5 gallons of solution or you should have a stick marked at 5-gallon intervals (Fig. 13, back cover) so the amount of solution to be added or remaining to be sprayed can be easily determined.

Use of Table 4

After you know how many acres you can spray with the amount of liquid the tank holds, you can find out how much chemical you will need to use from Table 4. If you can spray 20 acres with a tankful and you are to apply 1 pound of active ingredient per acre, you will have to add 20 pounds of active ingredient to the tank. If the chemical has 2.33 pounds of active ingredient per gallon, go to the column on the extreme left in Table 4 and find 20; then go to the top of the table and find the 2.33 pounds of active-ingredient-per-gallon column. Read from the top down to the line opposite the 20 pound figure. This shows you will need to add 34 quarts and 9 ounces to the tank.

If you are going to spray 15 acres at the rate of one-half pound of active ingredient per acre, you will have to add 7.5 pounds of active ingredient to the tank. If the chemical has 4 pounds of active ingredient per gallon, go to the column on the extreme left and find the combination of numbers that adds up to 7.5 pounds of active ingredient. In this case, 0.5, 2, and 5 pounds. Then go to the top of the table and find the 4-pounds-of-active-ingredient-per-gallon column and add the numbers in this column that correspond to 0.5, 2, and 5 pounds of active ingredient per gallon. In this instance, 0.5

Table 4. — Quarts of Pesticide per Tankful

Pounds of active ingredients to be added to the tank	Active ingredients — pounds per gallon							
	2 lb.		2.33 lb.		2.5 lb.		3 lb.	
	qt.		qt.	oz.	qt.	oz.	qt.	oz.
0.5	1			27.5		26		22
1	2		1	23	1	19	1	11
2	4		3	14	3	6	2	22
3	6		5	5	4	26	4	
4	8		6	28	6	12	5	11
5	10		8	18	8	0	6	22
10	20		17	5	16	0	12	11
20	40		34	9	32	0	26	22
40	80		68	18	64	0	53	11
60	120		102	27	96	0	80	0

	Active ingredients — pounds per gallon					
	3.5 lb.		4 lb.	5 lb.		6 lb.	
	qt.	oz.	qt.	qt.	oz.	qt.	oz.
0.5		18	0.5		13		11
1	1	5	1		26		21
2	2	9	2	1	19	1	11
3	3	14	3	2	13	2	0
4	4	18	4	3	6	2	22
5	5	23	5	4	0	3	11
10	11	14	10	8	0	6	21
20	22	28	20	16	0	13	11
40	45	23	40	32	0	26	22
60	68	19	60	48	0	40	

quarts, 2 quarts, and 5 quarts that, added up, means you add 7 quarts and 16 ounces of chemical to enough water to spray 15 acres.

In the same way, this table can be used to find out how much chemical to use for any number of pounds of active ingredient.

Use of Table 5

If a wettable powder is used, Table 5 can be used in the same manner as Table 4 to obtain the number of pounds of wettable powder to add to the tank. If you prefer to convert the decimal parts of a pound listed to ounces, multiply by 16. For example: 0.91 lb. times 16 ounces per lb. equals 14.56 ounces.

Use of Table 6

To use Table 6 properly, you should stake out, preferably in the field, 88 feet for slow speeds and 176 feet for fast speeds. Then with

Table 5. — Pounds of Wettable Powder per Tankful

Pounds of active ingredients needed	Percentage of active ingredients								
	40%	45%	50%	55%	60%	65%	70%	75%	80%
	(Pounds of wettable powder)								
0.5	1.25	1.1	1	0.9	0.83	.77	.71	.67	.62
1	2.5	2.2	2	1.8	1.7	1.54	1.4	1.3	1.25
2	5	4.4	4	3.6	3.3	3.1	2.9	2.7	2.5
3	7.5	6.7	6	5.4	5	4.6	4.3	4	3.75
4	10	8.9	8	7.3	6.7	6.2	5.7	5.3	5
5	12.5	11	10	9.1	8.3	7.7	7.1	6.7	6.25
10	25	22	20	18.2	16.7	15.4	14.3	13.3	12.5
20	50	44	40	36.4	33.3	31	28.5	26.7	25
40	100	89	80	73	67	46	57	53	50
60	150	133	120	109	100	62	86	80	75

Table 6. — Finding Ground Speed From Time Required to Travel a Set Distance

Distance, feet	88	88	88	176	176	176
Time, seconds	20	15	12	20	17	15
Ground speed, miles per hour	3	4	5	6	7	8

the rig up to speed before you pass the first stake and kept there until you pass the second, find how many seconds it takes to go between the two. (Use a watch with a second hand or a stop watch.) When you find the proper speed, mark the throttle setting so that you can easily duplicate it. You can use the table to convert time in seconds to miles per hour. If your tractor has a speed indicator it can be used, but should be checked for accuracy using this method.

Use of Table 7

If all the nozzles are producing the same amount, your sprayer should apply the gallons per acre you calculated from Table 2 if you travel the same speed. However, you may have made an error somewhere or conditions may change, so you should frequently check the application rate. To do this, Table 7 should be used. Note that it can be used for 4-, 6-, 8-, or 10-row swath widths and for several row spacings. To use the table measure the tank contents at one end of the field then spray for a half-mile distance and measure the tank contents again. For example, assume you measure 100 gallons in the tank and then spray with an eight-row sprayer for one-half mile by going one round in a quarter-mile field with 38-inch rows. Then if you measure 85 gallons in the tank you have used 15 gallons of spray. In the table, the nearest amount is 15.4 in the 10-gallons-per-acre

Table 7. — Determining Gallons per Acre During Application Using 0.5-Mile Travel Distance

Sprayer swath		Gallons needed to equal					
Number of rows	Row width (inches)	5 gal. per acre	6 gal. per acre	8 gal. per acre	10 gal. per acre	15 gal. per acre	20 gal. per acre
4	24	2.4	2.9	3.9	4.8	7.3	9.7
4	30	3.0	3.6	4.8	6.1	9.1	12.1
4	36	3.6	4.4	5.8	7.3	10.9	14.6
4	38	3.8	4.6	6.1	7.7	11.5	15.4
4	40	4	4.9	6.5	8.1	12.1	16.2
6	24	3.6	4.4	5.8	7.3	10.9	14.6
6	30	4.5	5.5	7.3	9.1	13.6	18.2
6	36	5.4	6.5	8.7	10.9	16.3	21.8
6	38	5.8	6.9	9.2	11.5	17.3	23
6	40	6.1	7.3	9.7	12.1	18.2	24.2
8	24	4.8	5.8	6.8	9.7	14.5	19.4
8	30	6.1	7.3	9.7	12.1	18.2	24.2
8	36	7.3	8.7	11.6	14.5	21.8	29.1
8	38	7.7	9.2	12.3	15.4	23	30.7
8	40	8.1	9.7	12.9	16.2	24.2	32.3
10	24	6.1	7.3	9.7	12.1	18.2	24.2
10	30	7.6	9.1	12.1	15.1	22.7	30.2
10	36	9.1	10.9	14.5	18.2	27.3	36.3
10	38	9.6	11.5	15.4	19.2	28.8	38.4
10	40	10	12.1	16.2	20.2	30.3	40.4

column, so the sprayer is applying slightly under 10 gallons per acre. Caution: Make sure the sprayer is level for each tank reading.

Sprayer maintenance

Most trouble with sprayers can be traced to foreign matter that clogs nozzles or strainers or even wears out pumps. Here are some suggestions for avoiding maintenance problems and prolonging the life of your sprayer.

1. Use only clean water. As a rule of thumb, use only water that looks clean enough to drink. Even tiny particles, such as are often found in water from ponds or a watering trough, can easily clog a nozzle screen. Some of these screens have as many as 40,000 openings per square inch. Take the water directly from a well if possible. If in doubt, filter the water as you fill the sprayer tank.

2. Do not permanently remove the screens from the sprayer. A sprayer will normally contain screens at three locations. One is a coarse screen on the end of the suction hose. Another is in the line between the pump and boom. The third and finest screen is in the nozzle. The nozzle screens should not normally be finer than 100 mesh. In most cases 200-mesh screens have much smaller openings than necessary and will be much more susceptible to clogging. The

screens should remain in the sprayer at all times with one possible exception — removing the nozzle screens when wettable powders are used. It is very difficult to keep wettable powders in 100-percent suspension and therefore they sometimes cause an excess amount of clogging of the nozzle screens. Otherwise you are more likely to get proper spray patterns and outputs by using all the screens. The line strainer should probably have a 50-mesh screen when wettable powders are used.

3. **Never use a metal object for cleaning nozzles.** Always remove the nozzle and clean out the dirt. Do not try to pick it out with a pin or knife. The nozzle orifice is precisely made to extremely close tolerances. One thrust of a hard metallic object will ruin the orifice.

4. **Flush new sprayers before you use them.** Unless properly cleaned, new sprayers will invariably clog. The reason is that the sprayer contains a large quantity of metal chips and dirt from the manufacturing process. Remove the nozzles and flush the sprayer and booms with clean water. Dismantle each nozzle and give it a thorough cleaning. Also check and clean the screens to remove all foreign particles completely.

5. **With 2,4-D, use separate barrels or tanks if possible.** One of the biggest problems in spraying is contamination from 2,4-D. Just rinsing a sprayer with water will not remove 2,4-D residues. These residues are worse in the sprayer tank than in the other parts of the sprayer. A simple solution on some sprayers is to use separate barrels when you spray with 2,4-D.

6. **Clean the sprayer thoroughly after each period of use.** When you change chemicals, it is often necessary to remove all residues completely. There are many reasons for this. The primary one is the removal of contamination that may cause damage. For example, spraying a legume crop to control insects after the sprayer has been used for applying 2,4-D may seriously damage the legume crop unless the sprayer has been thoroughly cleaned. In other cases there may be a reaction between chemicals that causes loss of effectiveness. Agents in emulsions may react with chemicals in wettable powders and cause loss of effectiveness or coagulation. When you are changing chemicals, especially from herbicides such as 2,4-D to other chemicals, the following procedure for cleaning sprayers is recommended.

(a) Remove and clean all screens and boom extensions with kerosene and a small brush.

(b) Mix one box of detergent with 30 gallons of water in the tank. Circulate through by-pass for 30 minutes; then drain.

(c) Replace the screens and boom extensions.

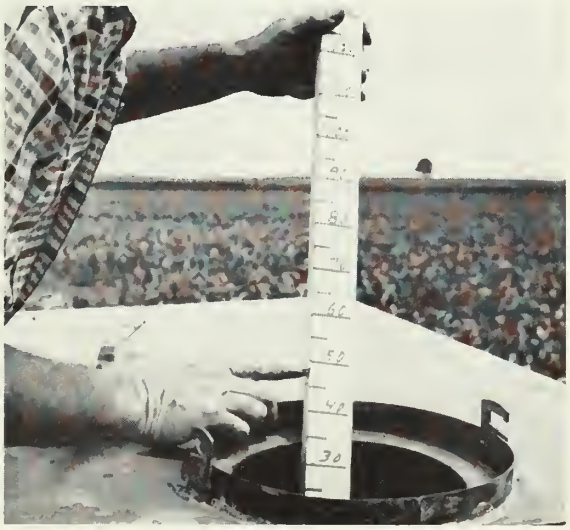
(d) Fill the tank one-third to one-half full with one part of household ammonia to 49 parts of water. Circulate this mixture through the pump and by-pass, allowing a small amount to go out through the nozzles. Let the remainder of the solution stand over night, and then run it out through the nozzles.

(e) Flush with two tankfuls of clean water by spraying through the boom with the nozzles removed. If the sprayer is to be stored for a long period, add a gallon of light non-detergent oil to the last tankful of water. This will coat all internal parts with oil as it is pumped out and cut corrosion considerally.

7. Do not lock pump solid to the tractor. Most power take-off pumps should be held with a chain to prevent rotation. Locking the pump solid with a metal bar usually results in misalignment of the bearing and consequently a short life for the pump (Fig. 12).

8. Prolong the life of the pump with proper care. Little damage

Using a short chain to prevent turning of the pump casing. (Fig. 12)



For tanks not marked at 5-gallon intervals, use a stick calibrated at 5-gallon intervals to find out how much solution is left in the tank. (Fig. 13)

will occur to the pump while it is in use. Water actually lubricates the working parts of the pump and prevents wear unless the water contains abrasive material. When the pump is not in use, store it in a dry place with the pump full of a light non-detergent oil. Pumps so protected should last for years. If pumps have a grease fitting, lubricate them moderately from time to time. Overlubrication can break seals and cause leakage.

9. Do not use corrosive fertilizer solutions in ordinary sprayers. Liquid fertilizers are very corrosive to copper, galvanized surfaces, brass, bronze, and steel. Just one use of a liquid fertilizer can completely ruin an ordinary sprayer. Sprayers made completely of stainless steel or aluminum are available for applying liquid fertilizers. Aluminum is satisfactory for liquid nitrogen but not mixed liquid fertilizers.

10. Off-season storage of sprayers is important. To prevent accumulation of corrosion or dirt particles, remove screens and nozzles and store them in light non-detergent motor oil. Store sprayer booms and hoses in a cool, dry location.

HOW TO AVOID SPRAY DAMAGE

1. Use only low-volatile esters or amines of 2,4-D. Do not spray with 2,4-D within one-half mile of tomato plants or grape vineyards.
2. Read the label on the chemical container and follow directions carefully and specifically.
3. To keep the particles large, use just enough pressure to produce a proper spray pattern.
4. Keep the nozzles close to the ground by using wide fan-angle nozzles. Use a single overlap of nozzle patterns.
5. Spray at the rate of at least 5 gallons to the acre and at as high a ground speed as is reasonable and safe.
6. Spray early in the morning, late in the evening, and at other times when there is little or no wind. If in doubt, don't spray.

This circular was prepared by B. J. Butler, Professor of Agricultural Engineering, and J. C. Siemens, Associate Professor of Agricultural Engineering.

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